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Influence of Al_2O_3 addition on the wear and corrosion behaviour of HVOF sprayed WC-12Co coatings

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Abstract

WC-12Co and 30wt.% of Al_2O_3 powder mixture was sprayed on EN-24 steel using high velocity oxy fuel (HVOF) method. The chemical, mechanical and tribological performances of WC-12Co and WC-12Co-Al_2O_3 coatings have been evaluated. XRD analysis clearly showed the presence of WC, Co and Al_2O_3 peaks in WC-12Co-Al_2O_3 coating. The FESEM studies showed a homogeneous microstructure with low amount of porosity in WC-12Co-Al_2O_3 samples as compared to WC-12Co coatings. An improved hardness of 1100 Hv was observed with the addition of Al_2O_3 content compared to 950 Hv (WC-12 Co). The 3D roughness profiles show a higher roughness of R_a ~ 7.6µm for Al_2O_3 incorporated coatings when compared to WC-12Co coating (Ra ~ 6.5µm). Dry sliding wear results of WC-12Co-Al_2O_3 coating exhibited higher wear resistance as compared to WC-12Co coating. This is probably due to low porosity levels and good metallurgical bonding between the EN24 substrate and the coating. Electrochemical impedance spectroscopy (EIS) studies showed better corrosion resistance for WC-12Co-Al_2O_3 coatings (I_{corr}=0.1µA, R_p= 2010Ω) as compared to WC-12Co (I_{corr}=0.9µA, R_p=406 Ω) coating. It is concluded that WC-12Co-Al_2O_3 coating exhibited better chemical, mechanical and tribological properties compared to WC-12Co coating under identical HVOF coating conditions.